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ELECTRONIC COMPUTERS IN CZECHOSLOVAKIA

By Jiri Benes

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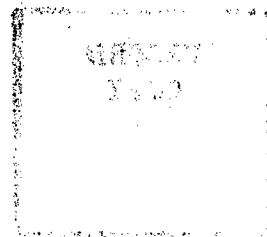
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ELECTRONIC COMPUTERS IN CZECHOSLOVAKIA

Following is a translation of an article by Jiri Benes in Vestnik Ceskoslovenske Akademie Ved (Report of the Czechoslovak Academy of Sciences) Vol. 69, No. 2, Prague, pages 214-217.

The development of science and technology and the necessities of national economy in Czechoslovakia create new tasks which can be successfully solved by using mathematical machines. Opinions dealing with basic questions of scientific organization which can be justly designated as cybernetic and a conscious orientation toward automation have contributed during the last few years to the development of mathematical machines the importance of which is generally accepted.

For a long time now the importance of electronic calculation in the field of the theory of automatic regulation has been emphasized for some time. Many research institutes have established research groups for the development of analogue computers. This work has been speeded up by the cooperation of the research institutes and by exchange of data obtained among the institutions e.g. in the field of stable amplifiers of one direction tension with automatic compensation by the moving of zero. Service simulators and especially small laboratory analogue computers of the type MEDA which are now produced in series have proved to be useful in works dealing with the theory and application of automatic regulation.

Other automatic machines were constructed for specific purposes by specialized groups within various research centers. These machines although they do not belong in the category of automatic electronic computers have - for their own purposes - an important role in the acquisition of data in experimental mathematics. Such are e.g. the electromechanical differential analyser DIANA of the Bush type which makes solutions possible in negatively evolving time; the relagating automatic computer SAPO which was already proposed earlier and which is a five address machine with moveable decimal point and six units and coding entry and exit which has a speed of 6,000 operations per hour and a drum like memory; computing machine for the calculation of crystalline structures and a machine for the synthesis of Fourier tables at the Institute of Technical Physics of CSAV; the APAR machine for the solution of sectional differential equations; Czechoslovak universal models of electrical networks using direct and alternating current with an armature of 500 Hz; semi-automatic synthesizer and analyser of relay circuits; the ADOP machine for the semi-

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automatic solution of the problems of linear programming (transportation problems) and other machines.

During recent years the number of specialists with experience in the field of electronic computers has increased substantially in Czechoslovakia. Among the diploma works at the Czech Polytechnical Institute in Prague there can be found a great number of realizations of logical circuits and mathematical instruments based on the modern theoretical foundations using transistors, ferrites, and miniaturizing technology. These works are primarily directed toward specialization in measurement and direction technology. Other such works are directed e.g. toward the analysis of casual processes and toward the formation of electronic machinery for such analysis (calculation of correlation functions, of short term correlations, histograms etc.).

At the mathematical physics faculty of Charles University in Prague the Chair of Applied Mathematics has introduced a specialization in "mathematics used in mathematical machinery".

Substantial portion of research work in the field of automatic computers is concentrated in the Research Institute of Mathematical Machinery in Prague which has already been a source for numerous works and studies in e.g. the theory of the numerical system of remnant classes. The publications of the workers of this Institute as well as those of other authors are published in the symposium "Machines for the Processing of Information" published by the Czechoslovak Academy of Sciences in Prague. The most recent volume is VI published in 1958 which contains also a multilingual dictionary of terms used in the field of machines for the numerical processing of information. Because the development of mathematical machines is complex in nature and because it demands close cooperation of various scientific and technical disciplines this institute was in 1958 included among the research institutes of the ministry of general machinery which increased the possibility of realization of various ideas and projects and which concentrated specialists who have until now worked in diffuse groups.

At the beginning of 1959 the increased interest in automation, in application of mathematical machines and in cybernetic meanings resulted in the formation of yet another institute: The Institute for the Theory of Information and Automation of CSAV in which joint work is produced by mathematicians and technologists residing in Prague.

This Institute deals with extremely advanced problems of the theory of information and questions concerning the utilization of computers in automatic regulation. This institute organized international conferences on the theory of information including the questions of coding whose materials are published. The materials from the June 1959 conference will be published in 1960 by the CSAV under the title: "Transactions of the Second Prague

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Conference on Information Theory. Decision Functions and Random Processes". This book will contain works in various languages: English, Russian, French, and German.

This institute is a member of the international association for cybernetics (Association Internationale de Cybernetique) which is located in Namur (Belgium) and the International Federation for Automatic Regulation (I.F.A.C. - International Federation of Automatic Control) which is located in Geneva (Switzerland) and whose first world congress will take place in Moscow in the summer of 1960. The Institute of Information Theory and Automation is about to join the I.F.I.P.S. - International Federation of Information Processing Societies which was organized at the first conference in UNESCO headquarters in Paris in June 1959.

An important role in the elaboration of suitable mathematical procedures for automatic computers is given to the Mathematical Institute of CSAV which belongs to its first section (section of mathematics and physics).

Having thus mentioned several institutes whose activity is related to electronic calculation we will examine briefly the state another factor important to the construction of mathematical machines i.e. the total standard of industry and manufacture of elements and parts. CSR has highly evolved industry producing complex machines and instruments and large cadres of workers used to exact work. It belongs among states exporting calculating machines with perforated cards and this tradition makes it possible to orient production easily to the manufacture of automatic electronic computers. The Czechoslovak optical industry is also capable of extremely accurate work e.g. manufacture of exact measuring instruments. CSR can also advantageously utilize the possibilities of its electrotechnical weak current industry which has developed significantly during the past ten years. At the present time CSR has an established mass production of electron sources and of pole conducting instruments including germanium diodes and transistors as well as production of ferrites and other important elements. Production of fine mechanical elements e.g. small motors, recording apparatus for magnetic drum like memory and of very accurate potencio-meters has been successfully solved. An original technological method for automatic winding of spiral (Screw type) potencimeters has been elaborated. The total effort in instrumental technology can be illustrated by the original construction of automatic photoelectric tracers of registered curves by accurate service multipliers, oscilloscopes etc.

It is therefore obvious that Czechoslovakia possesses important conditions for the production of electronic computers of either the analogue or numerical type. It should be also understood that CSR is totally conscious of its obligation to contribute to the progress in this field which is not one of the easiest ones.

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At the present time we are preparing the manufacture of the automatic computer EPOS which is a machine for various purposes and which can be expanded and combined along the building block principles. The estimated speed of this computer equals 16,000 operations per second. It is designated for scientific and technical calculations, for the processing of administrative data and for the direction of production and technological processes. At the same time many transforming elements are being developed e.g. coding equipment for the transition from analogue to numerical values etc.

In agreement with the general trend leading toward the utilization of computers for the direction of machinery CSR is producing original solutions in the field of computers designated specifically for the direction of processing machinery e.g. a linear interpolator for program direction in two parallels and also an interpolator for direction in 3 parallels etc. We can also point out a clear orientation toward simple and single purpose computers. Because Czechoslovakia is a country which has a traditional export of large numbers of processing machines the principle of origin of these computers and the patent law are strictly maintained.

From all that has been said about the production of the elements it can be seen that the construction of electronic analogue computers as well as of large and complex computers is a problem which will be solved within the nearest future.

To cover the demands in the field of automatic numerical calculation before automatic computers were manufactured in Czechoslovakia the Czechoslovakia Academy of Sciences imported an electronic numerical computer of the type URAL from the USSR. The experiences gained by operating this machine for scientific and technical calculations are very favorable and because of this we will shortly import several other computers of the same type. One of these computers has been supplied to the workers of the Prague Research Institute of Technical Economy assigned to the chemical industry at the beginning of 1960. Program workers are making preparations for the utilization of the URAL type machines in Prague and in Brno. In regard to the great variety of the mathematical machines produced for various scientific and administrative purposes it is clear that it is not efficient to produce a large number of types. It is favorable that in cases of specialized need Czechoslovakia imports some types of automatic computers within the framework of the trade agreements with the countries producing such computers.

The group which works at this time in the Institute of Information Theory and Automation of CSAV has constructed a mathematical machine based on probability counts. This machine which utilized radioactive radiation is designed to produce estimates in the field of statistical control of quality e.g. the calculation of sequence tests and take over planned tables. It was given the grand prize at the international exhibit in Brussels in 1958.

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Another instrument, the electronic generator of chance probabilities based on the hum of photomultipliers is important for the generation of Gaussian processes and for calculations using the Monte Carlo method.

We can also point out as an example some of the current utilization of electronic numerical calculation in Czechoslovakia. Besides the problems of flexibility and mechanics we can consider the calculation of optimum conditions for regulation circuits with monotone transmission characteristic, calculation of average quadratic deviation in non-linear systems which is affected by chance interference by the method of statistical linearization (this calculation demands the solution of integrals of Tarseval type), calculations of approximation by the development of orthogonal functions (Laguerre functions) etc. An example of the utilization of the electronic analogue calculation is the automatic regulation of large vats for energy blocks of 200 MW etc.

The utilization of automatic computers can be seen in the following main fields:

1. processing of administrative data and statistics,
2. scientific and technical calculations,
3. direct control of technological processes.

The perspective of electronic calculations in Czechoslovakia is very good: It is necessary to emphasize a definite tendency toward its utilization in automatic regulation of technological processes. Centralized processing of information obtained at individual points of measurement and the characterizing state of the dynamic system will find an important supplement in the utilization of processed results as directives for the elements which will affect other specific points of the system. The concept of a closed circuit of return bound amplifiers is receiving therefor a complex but attractive utilization. There are many ideas in Czechoslovakia concerning the basic analogy between the functions of regulation circuits and living organisms. General attention has been given to the problem of neuron models and to the probability logic of John von Neumann.

It seems that in the field of electronic calculation due among others to the swift technical development and the effort expended in various countries on closely related fields technical details of calculators and computers are gradually surpassed by the importance of the search for and the exchange of basic new ideas capable of broadening the knowledge and capability of man. This aspect of development of electronic computation can favorably influence human relations: The importance of the idea stated by the French philosopher Montaigne concerning the utility of "rubbing and filing of our brain against another brain" (Essais, book 1, chapter 25, year 1580, text from 1595) loses nothing of its value.

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Mathematical machines are important instruments of research. It is therefore correct to seek the foundations of the effort expended in CSR on the field of electronic computers primarily in care for the development of national economy and at the same time in the will to contribute generally to the progress of science and human knowledge.

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